Modified Konno Procedure for Tunnel Subaortic Stenosis

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Tunnel like subaortic stenosis, as the name implies, is a tubular narrowing of the left ventricular outflow tract. It is usually fibromuscular in nature. It is often a secondary lesion that is seen following earlier resection of a simple subaortic membrane. Scarring from the initial resection in conjunction with an abnormally shaped left ventricular outflow tract may result in progressive fibromuscular proliferation and the creation of a left ventricular outflow tract tunnel.

Subaortic stenosis resulting from tunnel like left ventricular outflow tract obstruction results in a pressure load on the left ventricle causing secondary ventricular concentric hypertrophy. In cases of severe concentric hypertrophy, failure of coronary arterial neovascularization to keep pace with muscular hypertrophy will result in subendocardial ischemia and a risk of sudden death from ventricular fibrillation. There is also a risk that the turbulent accelerated flow through the tunnel will cause injury to the aortic valve leaflets resulting in aortic valve regurgitation.

INDICATIONS FOR THE MODIFIED KONNO PROCEDURE VERSUS RESECTION FOR TUNNEL LIKE SUBAORTIC STENOSIS

Tunnel like subaortic stenosis can be managed by transaortic valve surgical resection or by the modified Konno procedure. Surgical resection for severe subaortic stenosis, eg, a peak to peak catheter gradient of greater than 50–60 mm requires extensive "coring out" of the left ventricular outflow tract. There is a significant risk of creation of an iatrogenic VSD. The risk of heart block is also quite high. The risk of recurrence is also high.

The modified Konno procedure is a useful intervention for the child with severe and possibly moderate to severe tunnel like subaortic stenosis so long as there is adequate development of the aortic valve annulus. The procedure avoids the risk of iatrogenic VSD creation in that there is deliberate VSD creation and planned closure. Because there is less extensive resection of the outflow tract the risk of complete heart block is probably less than for transaortic resection.

Preoperative studies must document that the pressure gradient across the left ventricular outflow tract is primarily in the tunnel and not at aortic valve level related to annular hypoplasia. If there is severe annular hypoplasia as the principal component of the left ventricular outflow tract pressure gradient then an annular enlarging procedure with replacement of the aortic valve is required. Often the aortic valve is bicuspid and at least mildly hypoplastic. A judgment must be made as to whether a residual pressure gradient will be tolerable if the aortic valve is preserved.

Tunnel like subaortic stenosis can result in aortic valve regurgitation. The onset of new audible aortic regurgitation is a traditional indication for surgical treatment of subaortic stenosis. More recently, the onset of mild or perhaps even trivial aortic regurgitation which is inaudible but can be documented by color Doppler mapping is also becoming accepted as an indication for surgical management of tunnel like subaortic stenosis.

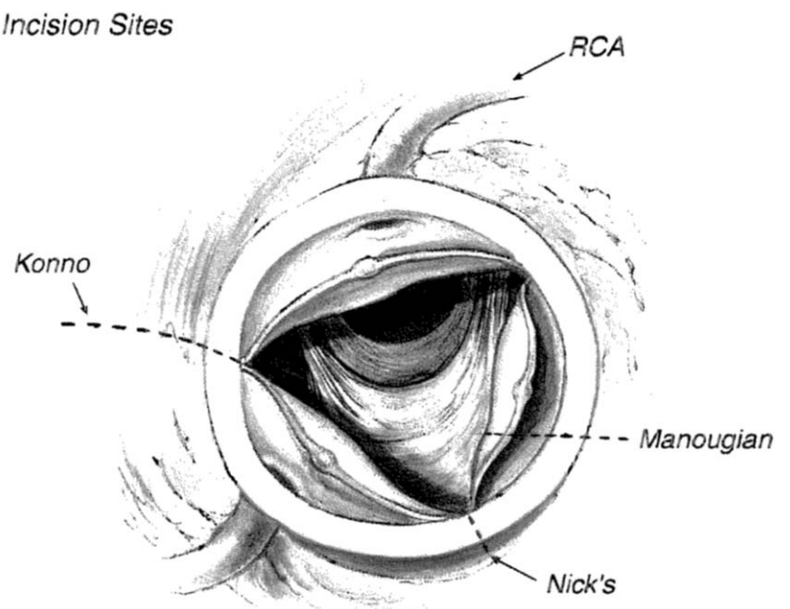
SURGICAL TECHNIQUE

Approach

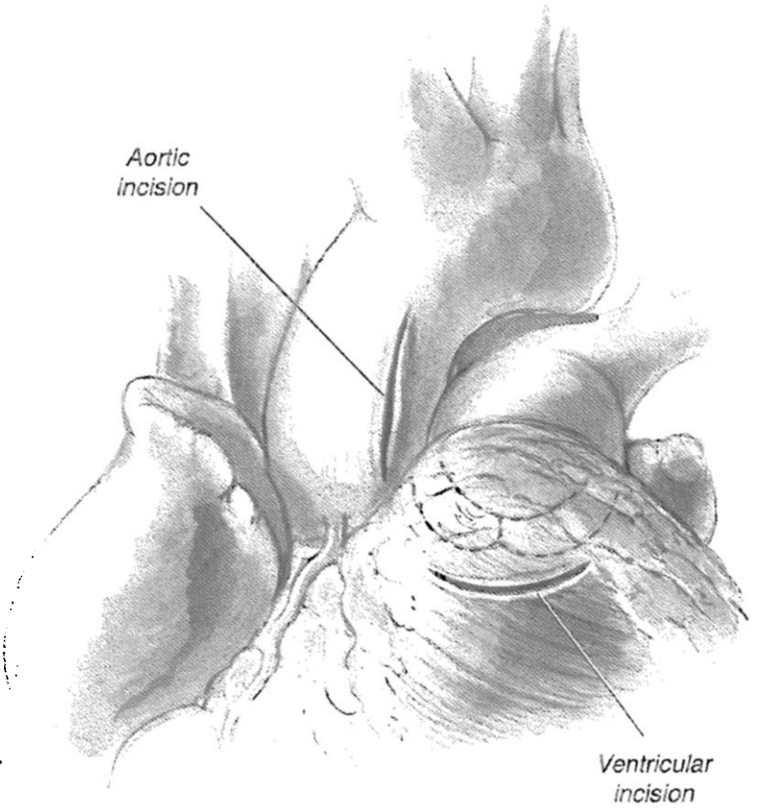
The patient is positioned supine on the table with slight elevation of the shoulders. A standard median sternotomy approach is employed. The thymus is subtotally resected. A patch of anterior pericardium is harvested and treated with 0.6% glutaraldehyde for 30 minutes. The remaining pericardium is supported with stay sutures particularly to lift the obtuse margin of the heart.

Cardiopulmonary Bypass Technique

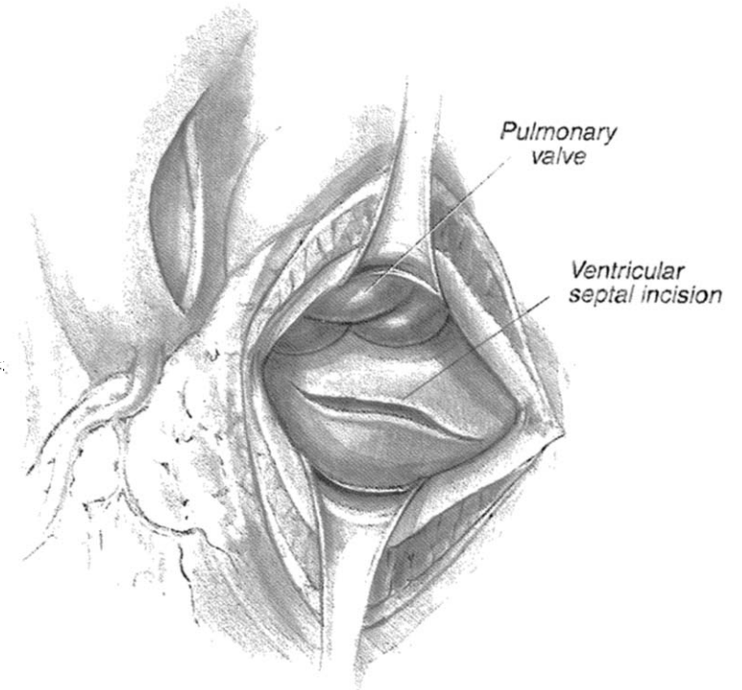
Two straight caval cannulae with caval tapes are employed with arterial cannulation of the ascending aorta. Moderate hypothermia at 25–28°C is usually appropriate. After aortic cross clamping standard cardioplegic arrest is instituted. A left ventricular vent is inserted through the right superior pulmonary vein.



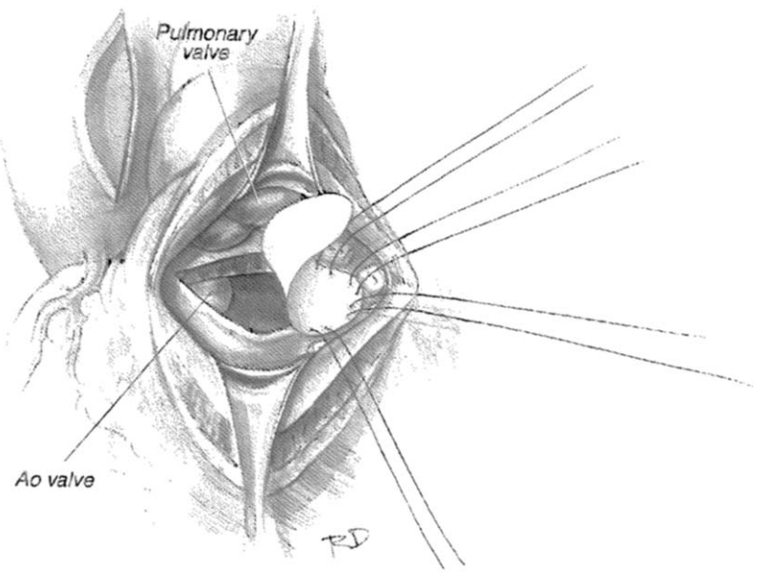
1 The aorta is opened with a vertical incision which extends to the left of the right coronary artery toward the intercoronary commissure of the aortic valve (Fig 1).



2 An oblique incision is made in the infundibulum of the right ventricle with this incision also directed toward the intercoronary commissure. Coronary artery branches are carefully preserved. The right ventricular aspect of the ventricular septum is exposed (Fig 2).



3 A right angle instrument is passed through the aortic valve (Fig 3). The tip of the instrument is used as a guide for the transmural septal incision. This incision can be challenging because of the extreme thickness of the ventricular septum in this condition. Once the incision has been carried through into the left ventricular outflow tract the right angle instrument is useful in separating the thickened septal edges. Working back and forth between the aortic incision and the septal incision, the septal incision is extended toward the intercoronary commissure of the aortic valve. Ideally the incision is carried superiorly above the level of the bellies of the cusps of the right and left coronary leaflets. Great care is taken not to injure the valve leaflets. The incision is carried leftward as far as is necessary to get beyond the inferior end of the tunnel. It is important that the incision be carried more leftward than apically to avoid injury to the conduction bundle. It is also important that the right ventricular aspect of the incision not be carried into the trabeculated anterior muscular septum. Undermining the inferior edge places the conduction bundle at risk. The superior edge can be undermined by muscle excision. Accessory fibrous tissue is often present and can be excised. This tissue may extend onto the anterior leaflet of the mitral valve.



4 A PTFE patch that is square ended is used to close the right ventricular aspect of the septal incision. This results in enlargement of the outflow tract by the thickness of the ventricular septum as well as adding to the circumference of the outflow tract by the width of the PTFE patch. The PTFE patch should be carefully anchored with interrupted pledgetted horizontal mattress sutures with particular care taken at the inferior and leftward end of the incision where it may be close to the trabeculated anterior muscular septum.

Closure of the Aortic and Infundibular Incisions

The aortic incision is often supplemented with a patch of glutaraldehyde treated autologous pericardium that is sutured into position using continuous prolene. The infundibular incision is also closed with autologous pericardium or possibly with a PTFE patch using PTFE suture.

Transaortic Valve Modification

The reason for using an incision that extends toward the intercoronary commissure is that on occasion it is useful to cut across the aortic annulus and separate the right and left leaflets of the aortic valve. This is only advisable when these leaflets are already somewhat thickened and suitable for subsequent supplementation with pericardial leaflet extenders following reconstitution of the annulus.

RESULTS

A review was undertaken of 46 patients who underwent surgery for complex and tunnel-like subaortic stenosis at Children's Hospital Boston between January 1990 and November 1998.[1] Forty-five of the 46 patients had tunnel like subaortic stenosis develop after repair of a primary congenital heart defect. Only one patient presented with de novo tunnel-like subaortic stenosis. Fifteen of the 45 patients had previously undergone repair of double outlet right ventricle. The remaining 30 had undergone repair of a variety of defects. The median age at the time of surgery for subaortic stenosis was 5 years (range 3–10 years). The modified Konno procedure was performed in 15 patients, a classical Konno procedure with aortic valve replacement in 3, Ross-Konno procedure in 2, and transaortic valve resection in 12 patients. Five patients with double outlet right ventricle underwent replacement of the interventricular baffle and 2 patients underwent an aortic valve preserving procedure in conjunction with mitral valve replacement.

There were no hospital deaths. None of the patients had an exacerbation of aortic regurgitation and none developed complete heart block. The median follow-up was 3 years (range 1 month to 8.5 years). Two patients developed recurrent subaortic stenosis defined as a gradient of 40 mm or greater as diagnosed by transthoracic echocardiography. Freedom from recurrent subaortic stenosis at 1, 3, and 5 years was 100, 94, and 86%, respectively.

CONCLUSION

The modified Konno procedure is a useful and safe procedure for management of complex and tunnel like subaortic stenosis. A careful decision must be made with each patient regarding possible need for enlargement of the aortic annulus and replacement of the aortic valve that is often stenotic and/or hypoplastic in

association with a tunnel like left ventricular outflow tract.

REFERENCES

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